

5           cathode, and a primary electricity using device  
6           within the external circuit, comprising the steps of  
7           A. providing a hydrogen containing fuel to the anode  
8           and an oxygen containing oxidant to the cathode  
9           to generate, for a first period of time, an  
10          electric current within the external circuit for  
11          operating the primary electricity using device,  
12          the cell operating conditions being selected such  
13          that, during the course of said first period of  
14          time, the cathode potential is maintained above  
15          0.66 volt and cell performance decreases;  
16           B. regenerating the cell after Step A by a)  
17           providing a hydrogen containing fuel to the anode  
18           while operating said cell using procedures  
19           selected to reduce the cathode potential to below  
20          0.50 volt, said procedures including the steps of  
21           i) stopping the flow of oxidant to the cell, ii)  
22           disconnecting the primary electricity using  
23           device and replacing it with a battery in the  
24           external circuit, and iii) providing a flow of  
25           hydrogen containing gas to the cathode, and  
26           b) maintaining the cathode potential below the  
27           said 0.50 volt for a second period of time  
28           sufficient to essentially restore the cell  
29           performance decrease which occurred during the  
30           course of Step A; and,  
31           C. sequentially repeating Steps A and B to reduce  
32           the decrease in cell performance over time.

Delete Claims 3-7 of the original patent and add new claims 10-19 as follows:

1       10. A method of operating a fuel cell having a PEM as the  
2       electrolyte, an anode on one side of the PEM, a cathode  
3       on the other side of the PEM, an external electric  
4       circuit connecting the anode and cathode, and a primary  
5       electricity using device within the external circuit,  
6       comprising the steps of

7       A. providing a hydrogen containing fuel to the anode  
8       and an oxygen containing oxidant to the cathode to  
9       generate, for a first period of time, an electric  
10      current within the external circuit for operating  
11      the primary electricity using device, the cell  
12      operating conditions being selected such that,  
13      during the course of said first period of time, the  
14      cathode potential is maintained above 0.66 volt and  
15      cell performance decreases;

16      B. regenerating the cell after Step A by  
17      a) providing a hydrogen containing fuel to the anode  
18      while operating said cell using procedures selected  
19      to reduce the cathode potential to below 0.50 volt,  
20      said procedures including the steps of i)  
21      disconnecting the primary electricity using device  
22      from the external circuit and connecting an  
23      auxiliary resistive load in its place, and  
24      ii) stopping the flow of oxidant to the cell and  
25      allowing the oxidant remaining within the cell to be  
26      consumed at the cathode creating a current flow  
27      through the auxiliary resistive load within the  
28      external circuit; and, b) maintaining the cathode  
29      potential below the said 0.50 volt for a second  
30      period of time sufficient to essentially restore the  
31      cell performance decrease which occurred during the  
32      course of Step A; and,

33      C. sequentially repeating Steps A and B to reduce the  
34      decrease in cell performance over time.

1       11. The method according to claim 10, wherein in Step B  
2       said cell operating procedures are selected to reduce

3           cathode potential to 0.1 volt or less for said second  
4           period of time.

1       12. A method of operating a fuel cell having a PEM as the  
2       electrolyte, an anode on one side of the PEM, a cathode  
3       on the other side of the PEM, an external electric  
4       circuit connecting the anode and cathode, and a primary  
5       electricity using device within the external circuit,  
6       comprising the steps of

7           A. providing a hydrogen containing fuel to the anode  
8       and an oxygen containing oxidant to the cathode to  
9       generate, for a first period of time, an electric  
10      current within the external circuit for operating  
11      the primary electricity using device, the cell  
12      operating conditions being selected such that,  
13      during the course of said first period of time, the  
14      cathode potential is maintained above 0.66 volt and  
15      cell performance decreases;

16      B. regenerating the cell after Step A while the  
17      primary electricity using device within the  
18      external circuit remains connected across the anode  
19      and cathode and while continuing to provide a  
20      hydrogen containing fuel to the anode and an oxygen  
21      containing oxidant to the cathode using procedures  
22      selected to reduce the cathode potential to below  
23      0.50 volt for a second period of time sufficient to  
24      essentially restore the cell performance decrease  
25      which occurred during the course of Step A, said  
26      procedures including increasing the oxidant  
27      utilization to at least 70% for said second period  
28      of time; and,

29      C. sequentially repeating Steps A and B to reduce the  
30      decrease in cell performance over time.

1       13. A method of operating a fuel cell having a PEM as the  
2       electrolyte, an anode on one side of the PEM, a cathode

3           on the other side of the PEM, an external electric  
4           circuit connecting the anode and cathode, and a primary  
5           electricity using device within the external circuit,  
6           comprising the steps of

7           A. providing a hydrogen containing fuel to the anode  
8           and an oxygen containing oxidant to the cathode to  
9           generate, for a first period of time, an electric  
10          current within the external circuit for operating  
11          the primary electricity using device, the cell  
12          operating conditions being selected such that,  
13          during the course of said first period of time, the  
14          cathode potential is maintained above 0.66 volt and  
15          cell performance decreases;

16          B. regenerating the cell after Step A while the  
17          primary electricity using device within the  
18          external circuit remains connected across the anode  
19          and cathode and while continuing to provide a  
20          hydrogen containing fuel to the anode and an oxygen  
21          containing oxidant to the cathode using procedures  
22          selected to reduce the cathode potential to below  
23          0.50 volt for a second period of time sufficient to  
24          essentially restore the cell performance decrease  
25          which occurred during the course of Step A, said  
26          procedures including increasing the current for  
27          said second period of time; and,

28          C. sequentially repeating Steps A and B to reduce the  
29          decrease in cell performance over time.

1           14. A method of operating a fuel cell having a PEM as the  
2           electrolyte, an anode on one side of the PEM, a cathode  
3           on the other side of the PEM, an external electric  
4           circuit connecting the anode and cathode, and a primary  
5           electricity using device within the external circuit,  
6           comprising the steps of

7           A. providing a hydrogen containing fuel to the anode  
8           and an oxygen containing oxidant to the cathode to  
9           generate, for a first period of time, an electric  
10          current within the external circuit for operating  
11          the primary electricity using device, the cell  
12          operating conditions being selected such that,  
13          during the course of said first period of time, the  
14          cathode potential is maintained above 0.66 volt and  
15          cell performance decreases;

16          B. regenerating the cell after Step A by  
17            a) providing a hydrogen containing fuel to the  
18            anode while operating said cell using procedures  
19            selected to reduce the cathode potential to below  
20            0.50 volt, said procedures including the steps of  
21            i) stopping the flow of oxidant to the cell and  
22            replacing it with a flow of inert gas, and  
23            ii) disconnecting the primary electricity using  
24            device from the circuit and connecting an auxiliary  
25            resistive load in its place; and,  
26            b) maintaining the cathode potential below the  
27            said 0.50 volt for a second period of time  
28            sufficient to essentially restore the cell  
29            performance decrease which occurred during the  
30            course of Step A; and,  
31          C. sequentially repeating Steps A and B to reduce  
32          the decrease in cell performance over time.

1           15. A method of operating a fuel cell having a PEM as the  
2           electrolyte, an anode on one side of the PEM, a cathode  
3           on the other side of the PEM, an external electric  
4           circuit connecting the anode and cathode, and a primary  
5           electricity using device within the external circuit,  
6           comprising the steps of  
7            A. providing a hydrogen containing fuel to the anode  
8            and an oxygen containing oxidant to the cathode to

9           generate, for a first period of time, an electric  
10          current within the external circuit for operating  
11          the primary electricity using device, the cell  
12          operating conditions being selected such that,  
13          during the course of said first period of time,  
14          the cathode potential is maintained above 0.66  
15          volt and cell performance decreases;

16          B. regenerating the cell after Step A by

17          a) providing a hydrogen containing fuel to the  
18          anode while operating said cell using procedures  
19          selected to reduce the cathode potential to below  
20          0.50 volt, said procedures including the steps of  
21          i) stopping the flow of oxidant to the cathode and  
22          replacing it with a flow of hydrogen, ii)  
23          disconnecting the primary electricity using device  
24          from the circuit and leaving the circuit open  
25          until the cathode potential falls to below 0.50  
26          volt; and, b) maintaining the cathode potential  
27          below the said 0.50 volt for a second period of  
28          time sufficient to essentially restore the cell  
29          performance decrease which occurred during the  
30          course of Step A; and,

31          C. sequentially repeating Steps A and B to reduce the  
32          decrease in cell performance over time.

1          16. A method of operating a fuel cell having a PEM as the  
2          electrolyte, an anode on one side of the PEM, a cathode  
3          on the other side of the PEM, an external electric  
4          circuit connecting the anode and cathode, and a primary  
5          electricity using device within the external circuit,  
6          comprising the steps of

7          A. providing a hydrogen containing fuel to the anode  
8          and an oxygen containing oxidant to the cathode to  
9          generate, for a first period of time, an electric  
10         current within the external circuit for operating

11           the primary electricity using device, the cell  
12           operating conditions being selected such that,  
13           during the course of said first period of time, the  
14           cathode potential is maintained above 0.66 volt and  
15           cell performance decreases;

16           B. regenerating the cell after Step A by

- 17           a) providing a hydrogen containing fuel to the  
18           anode while operating said cell using procedures  
19           selected to reduce the cathode potential to below  
20           0.50 volt, said procedures including the steps of  
21           i) stopping the flow of oxidant to the cell, and  
22           ii) disconnecting the primary electricity using  
23           device and replacing it with a power supply in the  
24           external circuit, and  
25           b) maintaining the cathode potential below the said  
26           0.50 volt for a second period of time sufficient to  
27           essentially restore the cell performance decrease  
28           which occurred during the course of Step A; and,

29           C. sequentially repeating Steps A and B to reduce the  
30           decrease in cell performance over time.

1           17. The method according to claim 16, including, in  
2           Step B, in addition to steps i) and ii), step iii)  
3           providing a flow of hydrogen containing gas to the  
4           cathode.

1           18. A method of operating a fuel cell having a PEM as the  
2           electrolyte, an anode on one side of the PEM, a cathode  
3           on the other side of the PEM, an external electric  
4           circuit connecting the anode and cathode, and a primary  
5           electricity using device within the external circuit,  
6           comprising the steps of

7           A. providing a hydrogen containing fuel to the anode  
8           and an oxygen containing oxidant to the cathode to  
9           generate, for a first period of time, an electric  
10          current within the external circuit for operating

11           the primary electricity using device, the cell  
12           operating conditions being selected such that,  
13           during the course of said first period of time, the  
14           cathode potential is maintained above 0.66 volt and  
15           cell performance decreases;

- 16           B. regenerating the cell after Step A by a)  
17           providing a hydrogen containing fuel to the anode  
18           while operating said cell using procedures selected  
19           to reduce the cathode potential to below 0.50 volt,  
20           said procedures including the steps of i) stopping  
21           the flow of oxidant to the cell and replacing it  
22           with a flow of gas selected from the group  
23           consisting of carbon dioxide, methane, natural gas,  
24           propane, and butane, and ii) disconnecting the  
25           primary electricity using device from the circuit  
26           and leaving the circuit open until the cathode  
27           potential falls to below 0.5 volt; and, b)  
28           maintaining the cathode potential below the said  
29           0.50 volt for a second period of time sufficient to  
30           essentially restore the cell performance decrease  
31           which occurred during the course of Step A; and,  
32           C. sequentially repeating Steps A and B to reduce  
33           the decrease in cell performance over time.

1           19. A method of operating a fuel cell having a PEM as the  
2           electrolyte, an anode on one side of the PEM, a cathode  
3           on the other side of the PEM, an external electric  
4           circuit connecting the anode and cathode, and a primary  
5           electricity using device within the external circuit,  
6           comprising the steps of

- 7           A. providing a hydrogen containing fuel to the anode  
8           and an oxygen containing oxidant to the cathode to  
9           generate, for a first period of time, an electric  
10           current within the external circuit for operating  
11           the primary electricity using device, the cell